COASTAL WASHINGTON SWISS NEEDLE CAST AERIAL AND GROUND SURVEY, 2018

Swiss needle cast is a fungal foliar disease of Douglas-fir. Impacts of infection include:

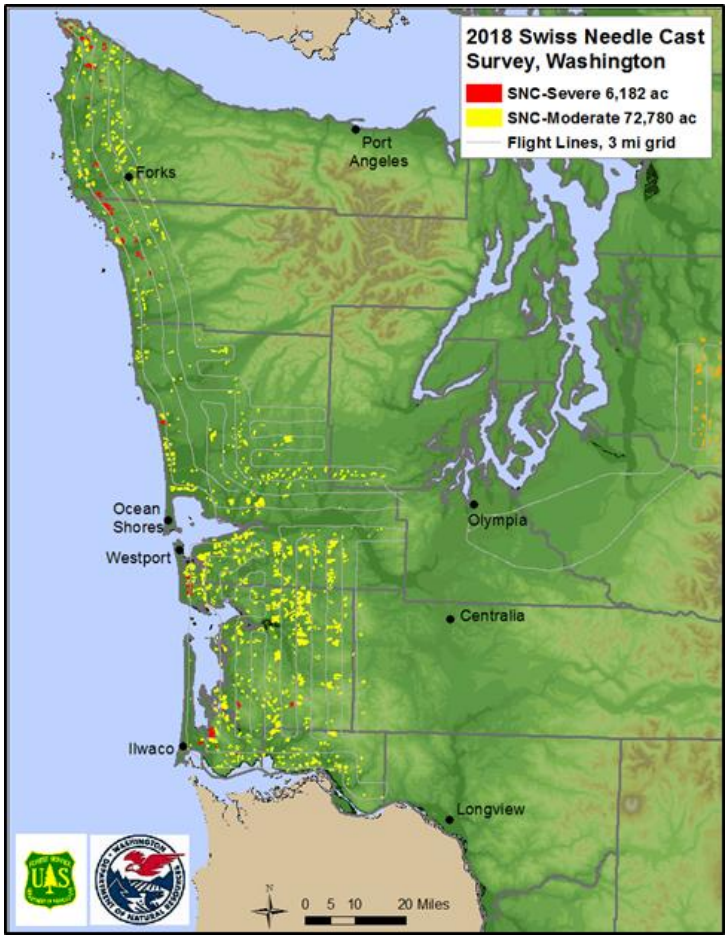
- Premature foliage loss and defoliation
- Reduced growth
- Alteration of wood properties
- Stand structure and forest development changes

Dates of Work: April-May, 2018

Total Acres Surveyed: 2.7 million

Swiss Needle Cast impacted Douglas-fir stand (yellow-brown crowns amongst light green alders) (above).

Map of 2018 Swiss Needle Cast aerial survey data (below).



Summary of Results:

- 79,000 acres recorded with SNC symptoms during aerial survey (3% of total area surveyed)
  - 68% decrease from acres mapped in 2016
- Similar foliar retention in Douglas-firs to 2016 observations.
- Lower fungal counts than those recorded in 2016.

Surveys Conducted by: Washington Department of Natural Resources, USDA Forest Service and Washington Department of Fish and Wildlife.

Coastal Washington Swiss Needle Cast Aerial and Ground Survey, 2018

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ABSTRACT

In late April and May, an aerial survey, covering 2.7 million acres, was flown to detect and map the distribution of Swiss Needle Cast (SNC) symptoms in coastal Washington (Figure 1). Nearly 79,000 acres of symptomatic Douglas-fir were mapped, which is a 68% decrease from the 248,000 acres mapped in the 2016 aerial survey and a 78% decrease from the 351,000 acres mapped in the 2015 aerial survey. Twenty-nine ground sites across the range of the aerial survey were surveyed for SNC incidence and severity, determined by counting fungal reproductive structures in the stomata of Douglas-fir needles, and Douglas-fir needle retention. An average of 2.3 years of foliage were on the trees across all sites, which is similar to the foliar retention surveyed in past years. The average percentage of occluded stomata on all sites was less than 1% for 2017 (1-year-old) foliage and 16% for 2016 foliage (2-years-old), both a reduction when compared to the data from the 2016 survey.

Figure 1. *Aerial photo of Swiss Needle Cast in Douglas-fir. The light green trees are alder and the infected Douglas-fir trees are yellowish-brown.*

INTRODUCTION

The fungus that causes SNC, *Phaeocryptopus gaeumannii* (T.Rohde) Petrak is found throughout the range of its only host, Douglas-fir (Shaw et al. 2011). Swiss Needle Cast causes premature foliage loss and defoliation and can reduce growth of host trees, alter wood properties, and affect stand structure and development (Johnson et al. 2005, Maguire et al. 2011, Weiskittel et al.

2006). The disease is most damaging near the coast due to the fungi-favorable climatic (mild winters and wet springs and summers) and topographic conditions.

An aerial survey for SNC has been conducted in the Oregon Coast Range since 1996, with over 300,000 acres of SNC symptomatic Douglas-fir mapped since 2006 and over 500,000 acres mapped each year since 2012 (Navarro and Norlander 2016).

In 2018 a SNC aerial survey was coupled with a ground survey in Washington. Ground surveys have been conducted in Washington since 1997, with aerial surveys occurring in 1998-2000, 2012, 2015, 2016 and 2018. The objective of the ground surveys is to monitor changes in incidence and severity of the disease over time.

METHODS

The aerial survey observation plane flew at 1,500 to 2,000 feet above the terrain, following north-south or east-west lines separated by 3 miles. Observers looked for areas of Douglas-fir forest with obvious yellow-brown foliage, a rather generic symptom that appears to be indicative of moderate to severe SNC disease. Patches of forest with these symptoms were sketched onto computer touch-screens displaying topographic maps or ortho-photos and the position of the aircraft. Each polygon was classified for degree of discoloration as either “S” (severe) or “M” (moderate). Polygons classified as “S” (CODE, SNC-S) had very sparse crowns and brownish foliage, while those classified as “M” (CODE, SNC-M) were predominantly yellow-brown foliage with slightly denser crowns than those classified as “S”.

The 2018 Washington SNC aerial survey was flown on April 26, May 3, 14, 17 and covered 2,675,000 acres. The survey is timed to occur when the crown color symptoms have developed, but before the new foliage has emerged (bud break) in late spring. The survey area extended from the Columbia River in Washington north to the Strait of Juan de Fuca, and from the coastline eastward.

Twenty-nine ground sites were included in the SNC survey. Stand color, landscape position, elevation, aspect and average tree age were recorded for each site. Foliar retention, diameter at breast height and crown color were recorded for ten trees at each site. Foliage from 2017 and 2016 were collected from the upper third of each of the ten trees at each site and taken back to the lab for microscopic examination of *P. gaeumannii* pseudothecia, a reproductive structure of the fungus. Three hundred stomata on each of ten needles from each foliage cohort were examined for pseudothecial occurrence.

RESULTS AND DISCUSSION

The aerial surveyors flew and made observations on 2.7 million acres of forest land in coastal Washington and mapped 79,000 of Douglas-fir with obvious symptoms of SNC (Figure 2). This is a 68% decrease from the 248,000 acres mapped during the 2016 SNC aerial survey (Figure 3, Table 1). The survey boundaries were similar to those in the 2012, 2015 and 2016 surveys.

	Severe SNC Symptoms		Moderate SNC Symptoms		Total Acres Mapped	
Year of Survey	% of total acres mapped	Severe SNC Acres	% of total acres mapped	Moderate SNC Acres	% with SNC symptoms	Total SNC Acres
2018	< 1%	6,000	3%	73,000	3%	79,000
2016	< 1%	14,000	10%	234,000	10%	248,000
2015	1%	19,000	13%	332,000	14%	351,000
2012	< 1%	6,000	8%	222,000	9%	228,000

Table 1. *Total acres with Swiss Needle Cast symptoms mapped during the aerial survey, by year.*

Swiss Needle Cast symptoms were detected on 3% of the total acres surveyed (Table 1). Severely symptomatic stands were generally located near Forks and the Neah Bay area and the most southwest corner of the survey, near Ilwaco. The cause of the decrease in mapped acres from 2016 to 2018 remains uncertain, but it is likely a combination of environmental factors influencing infections patterns and foliar retention, in addition to site and soil characteristics affecting water retention and soil nutrition on sites. Figure 4 shows how the 2018 SNC aerial survey compares to previous years SNC aerial surveys in Washington.

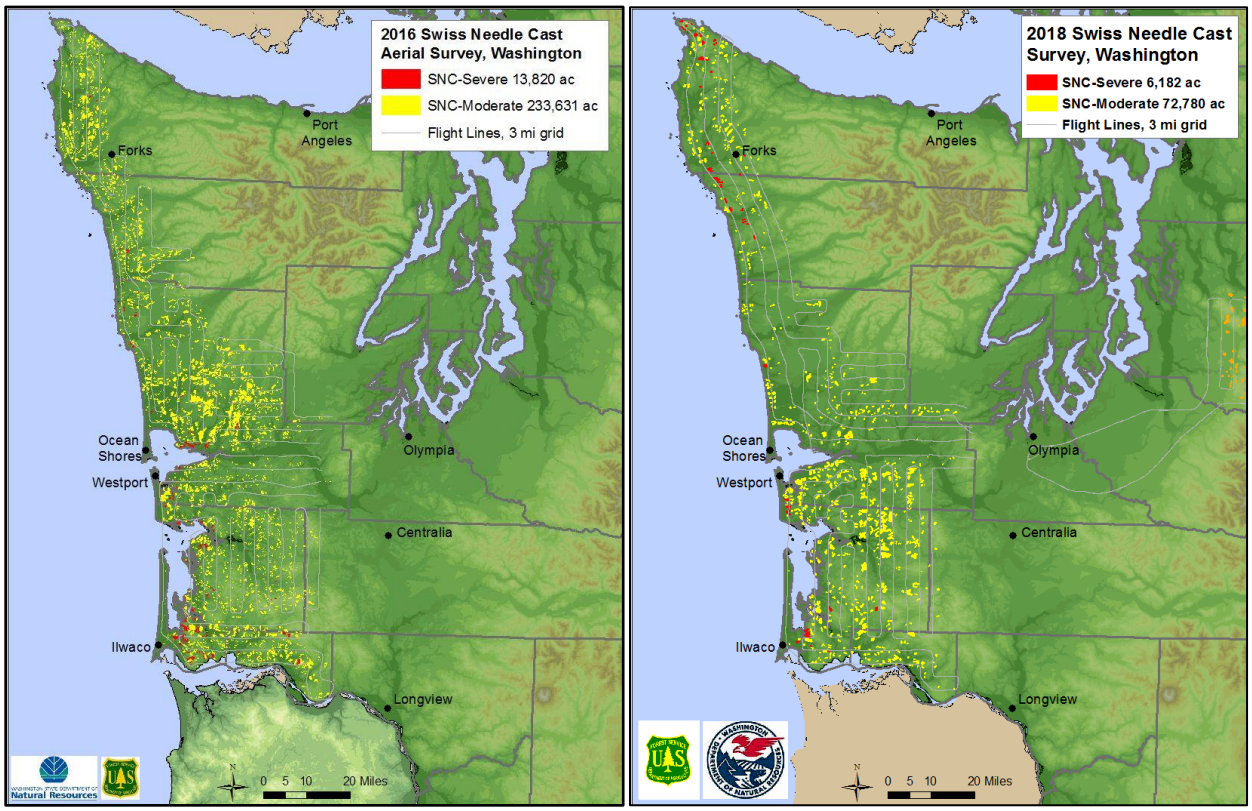

Figure 2 (right). *Washington 2018 Swiss needle cast (SNC) aerial survey map. 79,000 acres of affected area mapped.*

Figure 3 (left). *Washington 2016 Swiss needle cast aerial survey map. 248,000 acres of affected area mapped.*

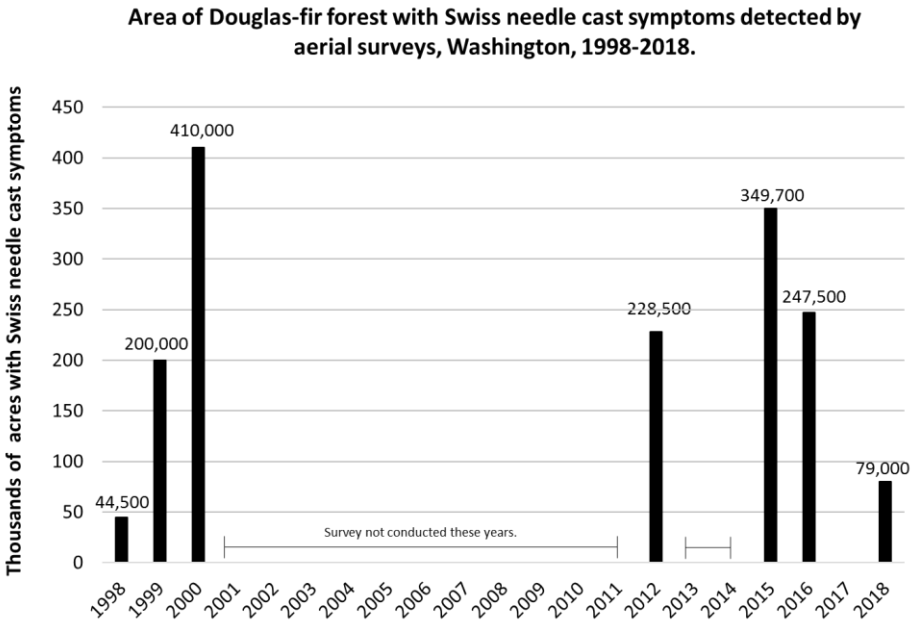

Figure 4. *Area of Douglas-fir forest with Swiss needle cast symptoms detected by aerial surveys in Washington, 1998-2018.*

The average percentage of occluded stomata across all sites was 1% for 2017 (1-year-old) foliage and 16% for 2016 foliage (2-years-old), with ranges from 0 to 82 percent, depending on the tree, site and needle age. Foliar retention varied across the survey area, ranging from 1.4 to 3.1 years, with an average of 2.3 years across all sixty-three ground survey sites. The amount of disease causing fungus in the foliage (pseudothecia) remains relatively stable across years of survey, as does the amount of foliage retained on sample trees (Figure 5).

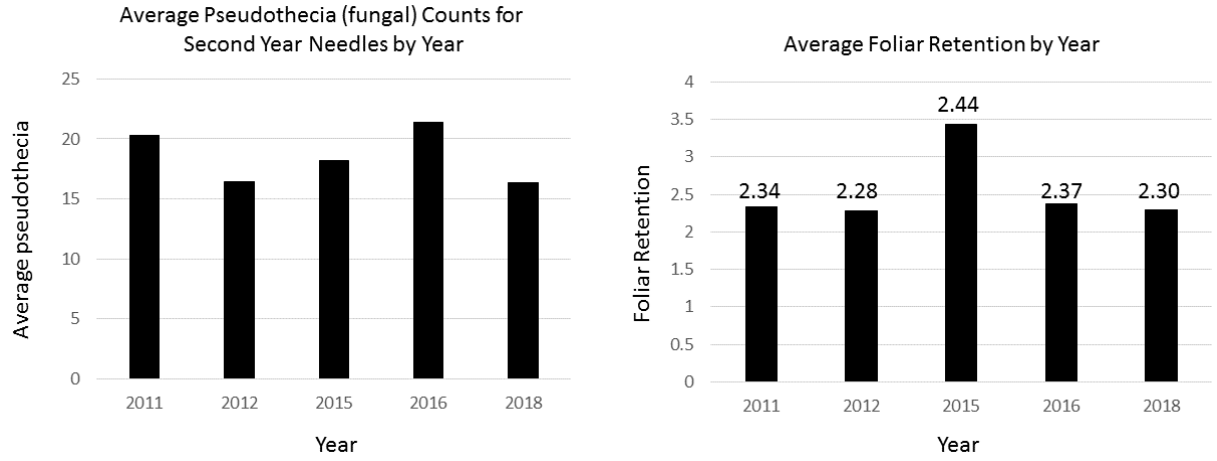

Figure 5. *Average psuedothecia counts for second year needle by year (left) and average foliar retention by year (right).*

Caution should be advised when interpreting aerial survey data. The SNC survey should be considered a conservative estimate of the acreage affected by SNC because aerial observers can only map areas where disease symptoms have developed enough to be visible from the air. SNC aerial survey can be used to coarsely document trends in damage over time. The ground data indicates that SNC is present in areas that were not mapped during the aerial survey. While the aerial survey can be used as a guide for identifying areas impacted by SNC, on the ground surveys should be conducted in stands of interest before SNC mitigating management decisions are made.

Douglas-fir is the only host of this disease, therefore forest managers can grow non-host species such as red alder, western red cedar, western hemlock and Sitka spruce in efforts to reduce damage from SNC. However, it should be noted that if Douglas-fir has more than three years of foliage on its branches, then damage in the form of growth loss are likely to be minimal to none.

For more information about foliar retention assessments or Swiss Needle Cast in general, this document has some great information.
http://sncc.forestry.oregonstate.edu/sites/default/files/ForestHealthFS.pdf.
For more information and details about the SNC aerial survey, follow this link to a great storyboard about the survey.
https://usfs.maps.arcgis.com/apps/MapJournal/index.html?appid=da5cda5003d24544b9231dbb8edf82fb

ACKNOWLEDGEMENTS

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ADDITIONAL NOTES

We appreciate any information regarding the accuracy or usefulness of the maps and ground survey data. Please contact Amy Ramsey (amy.ramsey@dnr.wa.gov or 360-902-1309) if you have questions, comments or suggestions.

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